Electrical preconditioning of stem cells with a conductive polymer scaffold enhances stroke recovery.

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Public Summary:
Human neural cells (hNPCs) are promising in their potential to be used as stroke therapeutics, but their optimal delivery conditions and exact recovery mechanisms remain elusive. To further investigate repair processes and improve stroke outcomes, we developed an electrically conductive polymer scaffold for cellular delivery. Electrical stimulation of hNPCs alters their RNA and the genes involved in cell survival, inflammatory response, and synaptic remodeling. In our experiments, hNPCs were electrically stimulated via the scaffold 1 day prior to implantation. After stimulation, hNPCs on the scaffold are transplanted intracranially in a stroke rat model. Electrically preconditioned hNPCs improved functional outcomes compared to control cells. The ability to manipulate hNPCs using a conductive scaffold creates a new approach to optimize stem cell-based therapy and determine which factors (such as VEGF-A) are essential for stroke recovery.

Scientific Abstract:
Exogenous human neural progenitor cells (hNPCs) are promising stroke therapeutics, but optimal delivery conditions and exact recovery mechanisms remain elusive. To further elucidate repair processes and improve stroke outcomes, we developed an electrically conductive, polymer scaffold for hNPC delivery. Electrical stimulation of hNPCs alters their transcriptome including changes to the VEGF-A pathway and genes involved in cell survival, inflammatory response, and synaptic remodeling. In our experiments, exogenous hNPCs were electrically stimulated (electrically preconditioned) via the scaffold 1 day prior to implantation. After in vitro stimulation, hNPCs on the scaffold are transplanted intracranially in a distal middle cerebral artery occlusion rat model. Electrically preconditioned hNPCs improved functional outcomes compared to unstimulated hNPCs or hNPCs where VEGF-A was blocked during in vitro electrical preconditioning. The ability to manipulate hNPCs via a conductive scaffold creates a new approach to optimize stem cell-based therapy and determine which factors (such as VEGF-A) are essential for stroke recovery.